Guidelines for the

Conduct of Research

in the

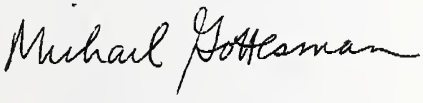
Intramural Research

Program at NIH

The *Guidelines for the Conduct of Research* expound the general principles governing the conduct of good science as practiced in the Intramural Research Programs at the National Institutes of Health. They address a need arising from the rapid growth of scientific knowledge, the increasing complexity and pace of research, and the influx of scientific trainees with diverse backgrounds. Accordingly, the *Guidelines* should assist both new and experienced investigators as they strive to safeguard the integrity of the research process.

The *Guidelines* were developed by the Scientific Directors of the Intramural Research Programs at the NIH and revised this year by the intramural scientists on the NIH Committee on Scientific Conduct and Ethics. General principles are set forth concerning the responsibilities of the research staff in the collection and recording of data, publication practices, authorship determination, peer review, confidentiality of information, collaborations, human subjects research, and financial conflicts of interest.

It is important that every investigator involved in research at NIH read, understand, and incorporate the *Guidelines* into everyday practice. The progress and excellence of NIH research is dependent on our vigilance in maintaining the highest quality of conduct in every aspect of science.



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Introduction

Scientists in the Intramural Research Program at the National Institutes of Health generally are responsible for conducting original research consonant with the goals of their individual Institutes, Centers and Divisions.

Intramural scientists at NIH, as all scientists, should be committed to the responsible use of the process known as the scientific method to seek new knowledge. While the general principles of the scientific method—formulation and testing of hypotheses, controlled observations or experiments, analysis and interpretation of data, and oral and written presentation of all of these components to scientific colleagues for discussion and further conclusions—are universal, their detailed application may differ in different scientific disciplines and in varying circumstances. All research staff in the Intramural Research Programs should maintain exemplary standards of intellectual honesty in formulating, conducting and presenting research, as befits the leadership role of the NIH.

These Guidelines were developed to promote high ethical standards in the conduct of research by intramural scientists at the NIH. It is the responsibility of each Laboratory or Branch Chief, and successive levels of supervisory individuals (especially Institute, Center and Division

Intramural Research Directors), to ensure that each NIH scientist is cognizant of these Guidelines and to resolve issues that may arise in their implementation.

These Guidelines complement, but are independent of, existing NIH regulations for the conduct of research such as those governing human subjects research, animal use, radiation, chemical and other safety issues, and the Standards of Conduct that apply to all federal employees.

The formulation of these Guidelines is not meant to codify a set of rules, but rather to elucidate, increase awareness and stimulate discussion of patterns of scientific practice that have developed over many years and are followed by the vast majority of scientists, and to provide benchmarks when problems arise. Although no set of guidelines, or even explicit rules, can prevent willful scientific misconduct, it is hoped that formulation of these Guidelines will contribute to the continued clarification of the application of the scientific method in changing circumstances.

The public will ultimately judge the NIH by its adherence to high intellectual and ethical standards, as well as by its development and application of important new knowledge through scientific creativity. ▲

Responsibilities of Research Supervisors and Trainees

Research training is a complex process, the central aspect of which is an extended period of research carried out under the supervision of an experienced scientist. This supervised research experience represents not merely performance of tasks assigned by the supervisor, but rather a process wherein the trainee takes on an increasingly independent role in the selection, conceptualization and execution of research projects. To prepare a young scientist for a successful career as a research investigator, the trainee should be provided with training in the necessary skills. It should be recognized that the trainee has unique needs relevant to career development.

In general a trainee will have a single primary supervisor but may also have other individuals who function as mentors for specific aspects of career development. It is the responsibility of the primary supervisor to provide a research environment in which the trainee has the opportunity to acquire both the conceptual and technical skills of the field. In this setting, the trainee should undertake a significant piece of research, chosen usually as the result of discussions between the mentor and the trainee, which has the potential to yield new knowledge of importance in that field.

The mentor should supervise the trainee's progress closely and interact personally with the trainee on a regular basis to make the training experience meaningful. Supervisors and mentors should limit the number of trainees in their laboratory to the number for whom they can provide an appropriate experience.

There are certain specific aspects of the mentor–trainee relationship that deserve emphasis. First, training should impart to the trainee appropriate standards of scientific conduct both by instruction and by example. Second, mentors should be particularly diligent to involve trainees in research activities that contribute to their career development. Third, mentors should provide trainees with realistic appraisals of their performance and with advice about career development and opportunities.

Conversely, trainees have responsibilities to their supervisors and to their institutions. These responsibilities include adherence to these Guidelines, applicable rules, and programmatic constraints related to the needs of the laboratory and institute. The same standards of professionalism and collegiality apply to trainees as to their supervisors and mentors. ▲

Data Management

Research data, including detailed experimental protocols, all primary data, and procedures of reduction and analysis are the essential components of scientific progress. Scientific integrity is inseparable from meticulous attention to the acquisition and maintenance of these research data.

The results of research should be carefully recorded in a form that will allow continuous access for analysis and review. Attention should be given to annotating and indexing notebooks and documenting computerized information to facilitate detailed review of data. All data, even from observations and experiments not directly leading to publication, should be treated comparably. All research data should be available to scientific collaborators and supervisors for immediate review, consistent with requirements of confidentiality. Investigators should be aware that research data are legal documents for purposes such as establishing patent rights or when the veracity of published results is challenged, and the data are subject to subpoena by congressional committees and the courts.

Research data, including the primary experimental results, should be retained for a sufficient period to allow analysis and repetition by others of published material resulting

from those data. In general, five to seven years is specified as the minimum period of retention, but this may vary under different circumstances.

Notebooks, other research data, and supporting materials, such as unique reagents, belong to the National Institutes of Health and should be maintained and made available, in general, by the Laboratory in which they were developed. Departing investigators may take copies of notebooks or other data for further work. Under special circumstances, such as when required for continuation of research, departing investigators may take primary data or unique reagents with them if adequate arrangements for their safekeeping and availability to others are documented by the appropriate Institute, Center or Division official.

Data management, including the decision to publish, is the responsibility of the principal investigator. After publication, the research data and any unique reagents that form the basis of that communication should be made available promptly and completely to all responsible scientists seeking further information. Exceptions may be necessary to maintain confidentiality of clinical data or if unique materials were obtained under agreements that preclude their dissemination. ▲

Publication Practices

Publication of results is an integral and essential component of research. Other than presentation at scientific meetings, publication in a scientific journal should normally be the mechanism for the first public disclosure of new findings. Exceptions may be appropriate when serious public health or safety issues are involved. Although appropriately considered the end point of a particular research project, publication is also the beginning of a process in which the scientific community at large can assess, correct and further develop any particular set of results.

Timely publication of new and significant results is important for the progress of science, but fragmentary publication of the results of a scientific investigation or multiple publications of the same or similar data are inappropriate. Each publication should make a substantial contribution to its field. As a corollary to this principle, tenure appointments and promotions should be based on the importance of the scientific accomplishments and not on the number of publications in which those accomplishments were reported.

Each paper should contain sufficient information for the informed reader to assess its validity. The principal method of scientific verification, however, is not review of submitted or published papers, but the ability of others to replicate the results. Therefore, each paper should contain all the information that would be necessary for scientific peers of the authors to repeat the experiments. Essential data that are not normally included in the published paper, e.g. nucleic acid and protein sequences and crystallographic information, should be deposited in the appropriate public data base. This principle also requires that any unique materials (e.g. monoclonal antibodies, bacterial strains, mutant cell lines), analytical amounts of scarce reagents and unpublished data (e.g. protein or nucleic acid sequences) that are essential for repetition of the published experiments be made available to other qualified scientists. It is not necessary to provide materials (such as proteins) that others can prepare by published procedures, or materials (such as polyclonal antisera) that may be in limited supply. ▲

Authorship

Authorship refers to the listing of names of participants in all communications, oral and written, of experimental results and their interpretation to scientific colleagues. Authorship is the fulfillment of the responsibility to communicate research results to the scientific community for external evaluation.

Authorship is also the primary mechanism for determining the allocation of credit for scientific advances and thus the primary basis for assessing a scientist's contributions to developing new knowledge. As such, it potentially conveys great benefit, as well as responsibility. For each individual the privilege of authorship should be based on a significant contribution to the conceptualization, design, execution, and/or interpretation of the research study, as well as a willingness to assume responsibility for the study. Individuals who do not meet these criteria but who have assisted the research by their encouragement and advice or by providing space, financial support, reagents, occasional analyses or patient material should be acknowledged in the text but not be authors.

Because of the variation in detailed practices among disciplines, no universal set of standards can easily be formulated. It is expected, however, that each research group and Laboratory or Branch will freely discuss and resolve questions of authorship before and during the course of a study. Further, each author should review fully material that is to be presented in public forums or submitted (originally or in revision) for publication. Each author should be willing to support the general conclusions of the study.

The submitting author should be considered the primary author with the additional responsibilities of coordinating the completion and submission of the work, satisfying pertinent rules of submission, and coordinating responses of the group to inquiries or challenges. The submitting author should assure that the contributions of all collaborators are appropriately recognized and that each author has reviewed and authorized the submission of the manuscript in its original and revised forms. The recent practice of some journals of requiring approval signatures from each author before publication is an indication of the importance of fulfilling the above. ▲

Peer Review and Privileged Information

Peer review can be defined as expert critique of either a scientific treatise, such as an article prepared or submitted for publication, a research grant proposal, a clinical research protocol, or of an investigator's research program, as in a site visit. Peer review is an essential component of the conduct of science. Decisions on the funding of research proposals and on the publication of experimental results must be based on thorough, fair and objective evaluations by recognized experts. Therefore, although it is often difficult and time-consuming, scientists have an obligation to participate in the peer review process and, in doing so, they make an important contribution to science.

Peer review requires that the reviewer be expert in the subject under review. The reviewer, however, should avoid any real or perceived conflict of interest that might arise because of a direct competitive, collaborative or other close relationship with one or more of the authors of the material under review. Normally, such a conflict of interest would require a decision not to participate in the review process and to return any material unread.

The review must be objective. It should thus be based solely on scientific evaluation of the material under review within the context of published information and should not be influenced by scientific information not publicly available.

All material under review is privileged information. It should not be used to the benefit of the reviewer unless it previously has been made public. It should not be shared with anyone unless necessary to the review process, in which case the names of those with whom the information was shared should be made known to those managing the review process. Material under review should not be copied and retained or used in any manner by the reviewer unless specifically permitted by the journal or reviewing organization and the author. ▲

Collaborations

Research collaborations frequently facilitate progress and generally should be encouraged. It is advisable that the ground rules for collaborations, including eventual authorship issues, be discussed openly among all participants from the beginning. Whenever collaborations involve the exchange of materials between NIH scientists and scientists external to NIH, a Material Transfer Agreement (MTA) or other formal written agreements may be necessary. Information about such agreements and other relevant mechanisms, such as licensing or patenting discoveries, may be obtained from each ICD's Technology Development Coordinator or the NIH Office of Technology Transfer. ▲

Human Subjects Research

Clinical research, for the purposes of these Guidelines, is defined as research performed on human subjects or on material or information obtained from human subjects as a part of human experimentation. All of the topics covered in the Guidelines apply to the conduct of clinical research; clinical research, however, entails further responsibilities for investigators.

The preparation of a written research protocol ("Clinical Research Protocol") according to existing guidelines prior to commencing studies is almost always required. By virtue of its various sections governing background; patient eligibility and confidentiality; data to be collected; mechanism of data storage, retrieval, statistical analysis and reporting; and identification of the principal and associate investigators, the Clinical Research Protocol provides a highly codified mechanism covering most of the topics covered elsewhere in the Guidelines. The Clinical Research Protocol is generally widely circulated for comment, review and approval. It should be scrupulously adhered to in the conduct of the research. The ideas of the investigators who prepared the protocol should be protected by all who review the document.

Those using materials obtained by others from patients or volunteers are responsible for assuring themselves that the materials have been collected with due regard for principles of informed consent and protection of human subjects from research risk. Normally, this is satisfied by a protocol approved by a human subjects committee of the institution at which the materials were obtained.

The supervision of trainees in the conduct of clinical investigation is complex . Often the trainees are in fellowship training programs leading to specialty or subspecialty certifications as well as in research training programs. Thus, they should be educated in general and specific medical management issues as well as in the conduct of research. The process of data gathering, storage, and retention can also be complex in clinical research, which sometimes cannot easily be repeated. The principal investigator is responsible for the quality and maintenance of the records and for the training and oversight of all personnel involved in data collection.

Epidemiologic research involves the study of the presence or absence of disease in groups of individuals. Certain aspects of epidemiologic research deserve special mention. Although an epidemiologist does not normally assume responsibility for a patient's care, it is the responsibility of the epidemiologist to ensure that the investigation does not interfere with the clinical care of any patient. Also, data on diseases, habits or behavior should not be published or presented in a way that allows identification of any particular individual, family or community. In addition, even though it is the practice of some journals not to publish research findings that have been partially released to the public, it may be necessary for reasons of immediate public health concern to report the findings of epidemiologic research to the study participants and to health officials before the study has been completed; the health and safety of the public has precedence.

Development and review of detailed protocols are as important in epidemiologic research as in clinical research and any other health science. However, the time for protocol development and review may be appropriately shortened in circumstances such as the investigation of acute epidemic or outbreak situations where the epidemiologic investigation may provide data of crucial importance to the identification and mitigation of a threat to public health. Nevertheless, even in these situations, systematic planning is of great importance and the investigator should make every attempt to formalize the study design in a written document and have it peer-reviewed before the research is begun.* ▲

*The section on epidemiological research is adapted from the GUIDELINES FOR THE CONDUCT OF RESEARCH WITHIN THE PUBLIC HEALTH SERVICE, January 1, 1992

Financial Conflicts of Interest

Potential conflicts of interest due to financial involvements with commercial institutions may not be recognized by others unless specific information is provided. Therefore, the scientist should disclose all relevant financial relationships, including those of the scientist's immediate family, to the Institute, Center or Division during the planning, conduct, and reporting of research studies, to funding agencies before participating in peer review of applications for research support, to meeting organizers before presentation of results, to journal editors when submitting or refereeing any material for publication, and in all written communications and oral presentations. ▲

Concluding Statement

These Guidelines are not intended to address issues of misconduct nor to establish rules or regulations. Rather, their purpose is to provide a framework for the fair and open conduct of research without inhibiting scientific freedom and creativity. ▲

These Guidelines were originally prepared by a Committee appointed by the NIH Scientific Directors. This third edition was prepared by the NIH Committee on Scientific Conduct and Ethics and approved by the NIH Scientific Directors.